Considering a Vineyard?

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Potential for a new enterprise:

• Determine if your site is suitable for a vineyard.
• Determine if there is a market for grapes in the area.
  – Winery (private, cooperative, or build your own)
  – Other outlets: Farmer markets, grocery stores, hobbyist.
• Select cultivars to plant.
  - Adaptation to your specific conditions.
  - Use (wine, table, juice, jam & jellies) & demand.
• Plant the vines, establish trellis & begin training.
  – Financing
• Develop a good management program.
  – Time available
  – Cultural practices
Is your site suitable for grapes?

<table>
<thead>
<tr>
<th>Climate</th>
<th>Topography</th>
<th>Soils</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Winter Temperatures *</td>
<td>• Elevation</td>
<td>• Drainage</td>
</tr>
<tr>
<td>• Spring Frosts</td>
<td>• Degree of Slope</td>
<td>• Moisture Holding Capacity</td>
</tr>
<tr>
<td>• Length of Growing</td>
<td>• Direction of Slope</td>
<td>• pH</td>
</tr>
<tr>
<td>Season</td>
<td>• Nearness to a</td>
<td>• Fertility</td>
</tr>
<tr>
<td></td>
<td>large body of water</td>
<td>• Organic Matter</td>
</tr>
<tr>
<td>• Growing Degree Days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Precipitation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* The most important climatic consideration
Winter Temperatures

Determine what cultivars can be grown & how productive they will be.

**Cane buds** are the most tender portion of a grape vine.

- A **compound bud with the potential** to produce 3 or more shoots.
  - 1° bud: The most productive.
  - 2° bud: Less productive; varies with type & cultivar.
    - American types 50% or less productive
    - French hybrids 60-80% as productive.
  - 3° bud: Very un-productive
## Classification of Vine Hardiness

Based on the temperature at which injury begins to occur

<table>
<thead>
<tr>
<th>Temp. (°F)</th>
<th>Category</th>
<th>Suitable Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 0</td>
<td>Very cold tender</td>
<td>Almost any.</td>
</tr>
<tr>
<td>-5</td>
<td>Cold tender</td>
<td>Most northern <em>vinifera</em>.</td>
</tr>
<tr>
<td>-10</td>
<td>Moderately Hardy</td>
<td>Hardy <em>vinifera</em>, moderately hardy French hybrids.</td>
</tr>
<tr>
<td>-15</td>
<td>Hardy</td>
<td>Hardy French hybrids, most <em>labrusca</em>.</td>
</tr>
<tr>
<td>≤ -20</td>
<td>Very hardy</td>
<td>Hardy <em>labrusca</em>, most <em>riparia</em> hybrids.</td>
</tr>
</tbody>
</table>
# Grape Cultivar Adaptation

<table>
<thead>
<tr>
<th>Harvest Season:</th>
<th>Early</th>
<th>Mid</th>
<th>Late</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climatic Zone: 5A</td>
<td>5A</td>
<td>5A</td>
<td>5A</td>
</tr>
<tr>
<td>Cold tender (-5)</td>
<td>T?</td>
<td>T?</td>
<td>N</td>
</tr>
<tr>
<td>Mod. Hardy (-10)</td>
<td>T</td>
<td>T?</td>
<td>N</td>
</tr>
<tr>
<td>Hardy (-15)</td>
<td>Y</td>
<td>Y?</td>
<td>T?</td>
</tr>
<tr>
<td>Very Hardy (-20)</td>
<td>Y</td>
<td>Y</td>
<td>T</td>
</tr>
</tbody>
</table>

- **Y** = Should be adapted.
- **T?** = Adaptability questionable, may not warrant testing.
- **T** = Testing is required
- **Y?** = Testing may be required
- **N** = Not adapted.
Under radiation freeze conditions, cold air is heavier and settles into low areas. Plant at least 50 ft above the valley floor.
# Length of the Growing Season

<table>
<thead>
<tr>
<th>Frost-Free Days</th>
<th>Suitability for Grapes</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 150</td>
<td><strong>Unacceptable</strong></td>
</tr>
<tr>
<td>150 to 160</td>
<td><strong>Marginal:</strong> Only early season maturing varieties.</td>
</tr>
<tr>
<td>160 to 170</td>
<td><strong>Satisfactory:</strong> Early &amp; most mid-season maturing varieties.</td>
</tr>
<tr>
<td>170 to 180</td>
<td><strong>Good:</strong> Early, mid-season &amp; some late-season varieties.</td>
</tr>
<tr>
<td>&gt; 180</td>
<td><strong>Excellent:</strong> Most varieties.</td>
</tr>
</tbody>
</table>

Is often very site specific.
Frost Free Days

@ 32°F, 50% probability
@ 28°F, 50% probability
ISU Armstrong R&D Farm Vineyard

Elevation:

- Reduces the risk of spring & fall frosts.
- Extends the growing season.
- Protection from low winter temperatures.
Length of the Growing Season

Elevation reduces the risk of spring & fall frosts.
- Cold air drainage.

Large bodies of water moderate the temperature.
- Delay warming up in the spring.
- Extend the growing season in the fall
Frost Free Days

@ 32° F, 50% probability
@ 28° F, 50% probability
## Growing Degree Days (Winkler)

<table>
<thead>
<tr>
<th>Region</th>
<th>Degree Days*</th>
<th>Suggested Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>≤ 2,500</td>
<td>Early ripening varieties to achieve high quality.</td>
</tr>
<tr>
<td>II</td>
<td>2,501 to 3,000</td>
<td>Early and mid-season table varieties.</td>
</tr>
<tr>
<td>III</td>
<td>3,001 to 3,500</td>
<td>High production of standard to good quality table wines.</td>
</tr>
<tr>
<td>IV</td>
<td>3,501 to 4,000</td>
<td>High production, but table wine quality will be acceptable at best.</td>
</tr>
</tbody>
</table>

* Base 50° F; Degree day = ((daily high + low) / 2) – 50
Precipitation

1-inch per week

- Varies with:
  a. Frequency of rain fall
  b. Rooting depth of the crop
    • Grapes are deep rooted.
  c. The soil’s moisture holding capacity.
    • Soil Texture
    • Soil depth
  d. Temperature, relative humidity, & wind as they affect transpiration.
  e. How the soil surface is maintained.
This is a map of annual precipitation averaged over the period 1961-1990. Station observations were collected from the NOAA Cooperative and USDA-NRCS SNOTEL networks, plus other state and local networks. The PRISM modeling system was used to create the gridded estimates from which this map was made. The size of each grid pixel is approximately 4x4 km. Support was provided by the NRCS Water and Climate Center.

http://www.ocs.orst.edu/pub/maps/Precipitation/Total/States/VT/vt.gif
Degree of Slope

- Soil moisture
  - Infiltration
  - Surface runoff
- Air drainage of frost protection.
- Soil erosion
- Cultural practices
Soils with “B”, “C” and “D” slopes are best suited for grapes.
Direction of the Slope

<table>
<thead>
<tr>
<th>Growing Condition</th>
<th>N</th>
<th>S</th>
<th>E</th>
<th>W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Available Sunlight</td>
<td>Lowest</td>
<td>Highest</td>
<td>Int. +</td>
<td>Int. -</td>
</tr>
<tr>
<td>Accumulation of Heat Units</td>
<td>Lowest</td>
<td>Highest</td>
<td>Int. -</td>
<td>Int. +</td>
</tr>
<tr>
<td>Need for Water</td>
<td>Lowest</td>
<td>Highest</td>
<td>Int. -</td>
<td>Int. +</td>
</tr>
<tr>
<td>Risk of a Spring Frost</td>
<td>Lowest</td>
<td>Highest</td>
<td>Int. -</td>
<td>Int. +</td>
</tr>
<tr>
<td>Risk of Fluctuating Winter Temperatures</td>
<td>Lowest</td>
<td>Highest</td>
<td>Int. -</td>
<td>Int. +</td>
</tr>
</tbody>
</table>

If the length of the growing season is marginal for a cultivar, select a south facing slope.
Soil Selection Factors

• Internal Drainage
• Moisture Holding Capacity
  Texture
  Depth
• pH
• Fertility
County Soil Surveys

- **Soil Series Description:**
  Texture, Drainage, Fertility, Erosion
- **Soil Profile Classification:**
  Structure
- **Table of Engineering Index Properties:**
  Soil texture classification by depth
- **Table of Physical & Chemical Properties:**
  Permeability, Available water holding capacity, Organic matter content
## Soil Internal Drainage Classification

<table>
<thead>
<tr>
<th>Drained Condition</th>
<th>Suitability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very poorly drained</td>
<td>AVOID</td>
</tr>
<tr>
<td>Poorly drained</td>
<td>Avoid</td>
</tr>
<tr>
<td>Somewhat poorly drained</td>
<td>Marginal</td>
</tr>
<tr>
<td>Moderately well-drained</td>
<td>Suitable</td>
</tr>
<tr>
<td>Well-drained</td>
<td>Ideal</td>
</tr>
<tr>
<td>Excessively drained</td>
<td>Marginal</td>
</tr>
</tbody>
</table>

Always best to dig test holes to check the drainage.
Reasons for Poor Soil Drainage

- Poor surface runoff
  - Slope
  - Depressions
- Lateral seepage
  - On slopes
  - Textural change
- Texture
  - High clay content
- Impervious layer in substrata
  - Clay layer
  - Compacted layer
  - Abrupt textural change
- High water table
Dig Soil Test Holes

Test Holes:
• 3 feet deep
• Fill with water
• Check after 72 hrs
• If water is still present:
  - Find another site
  - Take corrective measures
What Can be Done to Improve Soil Drainage

- **Sub-soil before planting**
  - Effective for compacted soils if there is good soil below.

- **Plant on raised beds**
  - Suitable on moderately well drained soils.
  - Maybe okay for somewhat poorly drained soils.

- **Install drainage tile**
  - Suitable for somewhat poorly drained soils.
  - Maybe okay of poorly drained soils (distance between tile lines & cost become a factor).
Moisture Holding Capacity
Soil Texture + Soil Depth

Available Moisture

<table>
<thead>
<tr>
<th>Texture</th>
<th>Inches Per foot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>0.5</td>
</tr>
<tr>
<td>Loamy sand</td>
<td>1.0</td>
</tr>
<tr>
<td>Sandy loam</td>
<td>1.5</td>
</tr>
<tr>
<td>Loam</td>
<td>2.0</td>
</tr>
<tr>
<td>Silt loam</td>
<td>2.5</td>
</tr>
<tr>
<td>Clay loam</td>
<td>2.5</td>
</tr>
<tr>
<td>Clay</td>
<td>2.0</td>
</tr>
</tbody>
</table>
Soil pH for Grapes

• **Desired range:** 5.5 to 6.5
  - American: 5.0 to 6.5 (~ 6.0 optimum)
  - French Hybrid: 5.5 to 6.5; (6.0 to 6.5 optimum)
    • Will tolerate a pH up to ~ 7.0

• **Adjust Soil pH:**
  - Below 6.0: bring up to 6.0 or 6.5 with lime.
  - Above 6.8 or 7.0: consider lowering to 6.5 or 6.0 with sulfur, or using acid forming fertilizers (ammonium sulfate).
Lime Requirement to Raise the Soil pH to 6.5 and 6.0

Buffer pH

Tons of Limestone / Acre

pH 6.5

pH 6.0

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Sulfur Requirement to Reduce the Soil pH to 6.5

Lbs sulfur required to adjust the top 8 inches of soil.

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Soil pH

Nutrient Availability as Influenced by Soil pH

- Nitrogen (N)
- Phosphorous (P)
- Potassium (K)
- Calcium (Ca)
- Magnesium (Mg)
- Sulfur (S)
- Iron (Fe)
- Manganese (Mn)
- Boron (B)
- Copper (Cu)
- Zinc (Zn)
- Molybdenum (Mo)
Iron Chlorosis

Soil pH 8.0

Photographed by Eli Bergmeier
Soil Fertility

• **Least concern when selecting a site.**
  – Can amend the soil.

• **Concerns:**
  – **P** Immobile in the soil.
    • Pre-plant application is the only economical chance to correct a shortage.
    • Often high where manure has been applied.
  – **K** Grapes have a high requirement for K.
    • Can stratify where cultivation is not practiced as in a vineyard.
    • Excessive soil Mg can inhibit the uptake of K.
  – **Mg** Can be low in many eastern soils, particularly on sandier soils.
    • Uptake of Mg can be inhibited where K has been over-applied.
  – **Zn** Grapes have a relatively high requirement for Zn.
Pre-plant Soil Test

- Test for: pH, P, K, Zn, Mg, O.M.
- Submit serial samples collected from 2 depths:
  - 0 to 6 or 0 to 8 inch depth.
  - 6 to 12 or 8 to 16 inch depth.
## Desirable Soil Test Ranges for Grapes

<table>
<thead>
<tr>
<th>Test</th>
<th>Bul. 861*</th>
<th>ISU</th>
<th>U of MN</th>
<th>U of VT</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>5.5 to 6.5</td>
<td>6.0 to 6.5</td>
<td>6.0 to 7.0</td>
<td>✓</td>
</tr>
<tr>
<td>Organic matter</td>
<td>2 to 3 %</td>
<td>2 to 3 (4) %</td>
<td>-</td>
<td>✓</td>
</tr>
<tr>
<td>Phosphorous (P)</td>
<td>20 to 50 ppm</td>
<td>&gt; 30 ppm</td>
<td>&gt; 25 ppm</td>
<td>✓</td>
</tr>
<tr>
<td>Potassium (K)</td>
<td>125 to 150 ppm</td>
<td>&gt; 150 ppm</td>
<td>&gt; 150 ppm</td>
<td>✓</td>
</tr>
<tr>
<td>Calcium (Ca)</td>
<td>- -</td>
<td>- -</td>
<td>&gt; 600 ppm</td>
<td>✓</td>
</tr>
<tr>
<td>Magnesium (Mg)</td>
<td>100 to 125 ppm</td>
<td>100 to 125 ppm</td>
<td>~ 100 ppm</td>
<td>✓</td>
</tr>
<tr>
<td>Boron (B)</td>
<td>.75 to 1.0 ppm</td>
<td>- -</td>
<td>&gt; 1 ppm</td>
<td>✓</td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td>4 to 5 ppm</td>
<td>4 to 5 ppm</td>
<td>&gt; 1 ppm</td>
<td>✓</td>
</tr>
<tr>
<td>Manganese (Mn)</td>
<td>- -</td>
<td>- -</td>
<td>&gt; 6 ppm</td>
<td>✓</td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>- -</td>
<td>- -</td>
<td>&gt; 0.2 ppm</td>
<td>✓</td>
</tr>
<tr>
<td>Iron (Fe)</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Sulfur (S)</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

* Midwest Small Fruit Pest Management Handbook
Soil Organic Matter

• Improves soil structure, moisture retention and fertility.
  – 2 to 3% is considered ideal for grapes.

• Midwest Soils:
  – Range from < 1% up to 20%
  – Well-drained soils in the 3 to 4% range
  – OM is higher in poorer drained soils.

• Vermont soils vary:
  – Higher in the Champlain Valley.
  – Low in the river valleys.

• Grapes grown on high organic soils tend to be less winter hardy.

  Release of N from organic matter.

  20 lb N / % OM / Ac / Yr
Nitrogen Released from Organic Matter

![Graph showing the relationship between soil organic matter and nitrogen release. The x-axis represents % Soil Organic Matter, ranging from 0 to 10. The y-axis represents Lbs Actual N per Acre, ranging from 0 to 240. The graph includes bars for different % Soil Organic Matter values, with question marks and an 'X' indicating specific data points.](image-url)
Weighted Average Organic Matter - All Horizons (kg x 100 / sq. m)

http://www.geobabble.org/~hnw/esri98/P33310.GIF
# Vermont Soils

<table>
<thead>
<tr>
<th>Champlain Valley</th>
<th>River Valleys</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Silty to clayey soils.</td>
<td>• Sandy to loamy soils</td>
</tr>
<tr>
<td>• Most are naturally acid &amp; liming has been done.</td>
<td>• They are naturally acid &amp; liming has been done.</td>
</tr>
<tr>
<td></td>
<td>• Low CEC.</td>
</tr>
<tr>
<td></td>
<td>• Low in Mg.</td>
</tr>
<tr>
<td></td>
<td>• High in P.</td>
</tr>
<tr>
<td></td>
<td>• Naturally high</td>
</tr>
<tr>
<td></td>
<td>• From manure</td>
</tr>
<tr>
<td></td>
<td>• B can be low</td>
</tr>
<tr>
<td></td>
<td>• B can be low</td>
</tr>
<tr>
<td>• Band of calcareous soils near the lake w/ a naturally high pH.</td>
<td></td>
</tr>
<tr>
<td>• High CEC.</td>
<td></td>
</tr>
<tr>
<td>• High in K.</td>
<td></td>
</tr>
<tr>
<td>• Some relatively high Mg.</td>
<td></td>
</tr>
<tr>
<td>• Low in P</td>
<td></td>
</tr>
</tbody>
</table>
Pre-plant Soil Test

• Test for: pH, P, K, Mg, Zn, O.M. (B)
• Separate sample for each soil type.
• Separate samples for different cropping histories.
• Submit samples collected from 2 depths:
  – 0 to 6 inch, or 0 to 8 inch depth.
  – 6 to 12 inch, or 8 or 16 inch depth.
• Have your Extension specialist look over the results.
Cost of Establishing a Vineyard
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Dept. of Horticulture

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http://viticulture.hort.iastate.edu/home.html

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The Cost to Establish a Vineyard workbook is designed to report all the income and expense of a one-acre vineyard for up to 13 years. There are three different vineyard workbooks, each for a different trellis style.

- High Trellis
- Geneva Double Curtain
- Vertical Shoot Position

- **Winery Ten Year Financial Planning Workbook (version 5)**
  - Errors in the asset worksheet of version 1 were found in Column J that may affect the total investment. If you are using version 1 please check the numbers in cell J35, J49, and J185. Also check to see if the numbers add up correctly on line 181.

- **Estimated Vineyard Establishment with a High Trellis and Production Cost Per Acre**
- **Estimated Vineyard Establishment with a Geneva double Curtain and Production Cost Per Acre**
- **Estimated Vineyard Establishment with a Vertical Shoot Position and Production Cost Per Acre**
Factors Affecting the Cost of Vineyard Establishment

- Vine spacing (number per acre)
- Cost of the vines
- Method of planting
  - By hand, w/ an auger, or planting machine
- Length of the rows
- Line post spacing (post per acre)
- Method used to install the line post
  - Post driver, or post hole auger
- End post design (Anchored vs H-Brace)
- Number of wires per row (training system)
Vine Cost per Acre

- $0.00
- $500.00
- $1,000.00
- $1,500.00
- $2,000.00
- $2,500.00
- $3,000.00
- $3,500.00

Cost per Acre

- 6 x 9 ft
- 7 x 9 ft
- 8 x 9 ft
- 6 x 10 ft
- 7 x 10 ft
- 8 x 10 ft
- 6 x 12 ft
- 7 x 12 ft
- 8 x 12 ft

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Cost of Trellis Materials per Acre
Trellis Systems

Single Curtain Bi-lateral Cordon (Hi-Trellis)
- 2 wires

6-cane Kniffen
- 3 wires

Catch Wire System (VSP)
- 7 wires

Geneva Double Curtain
- 3 - 4 wires
Cost of Trellis Material
by Training System*

* With H-brace end post system

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Vineyard Establishment Workbooks

Assumptions

• Vines @ $ 1.75 (Maréchal Foch )
• 8 x 10 ft spacing (545 vines/A)
• Trained to a hi-trellis (single curtain cordon)
• Plant by machine
• H-Brace w/ short end post
• Labor @ $8.69 ($8.00/hr + FICA)
• Financed @ 6% interest
• Production @ $1,000 per ton
  – Year 3  1.5 tons
  – Year 4  3.0 tons
  – Year 5 +  3.5 tons
Hi-Trellis Establishment Budget

Maréchal Foch

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Vineyard Establishment Workbooks
Assumptions

• Vines @ $2.50 (Frontenac)
• 8 x 10 ft spacing (545 vines/A)
• Trained to a hi-trellis (single curtain cordon)
• Plant by machine
• H-Brace w/ short end post
• Labor @ $8.69 ($8.00/hr + FICA)
• Financed @ 6% interest
• Production @ $1,000 per ton
  – Year 3 2.0 tons
  – Year 4 4.0 tons
  – Year 5 + 5.0 tons